Task Effects on Binaural Cue Representation in Human Auditory Cortex

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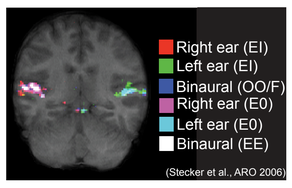
Background

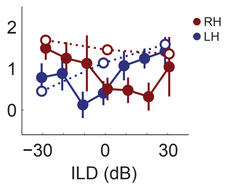
Auditory cortical (AC) neurons typically respond more strongly to contralateral than ipsilateral stimuli. This response pattern is manifested in human fMRI as increased activation in each hemisphere to sound in the contralateral hemifield.

Task engagement shapes responses of cortical neurons in cats (Lee and Middlebrooks 2011), and influences cortical activation in lateral parts of auditory cortex (Petkov et al. 2004; Woods et al. 2009).

Question: How is cortical activity in response to spatial cues (interaural time [ITD] and level [ILD] differences), influenced by the context of task engagement?

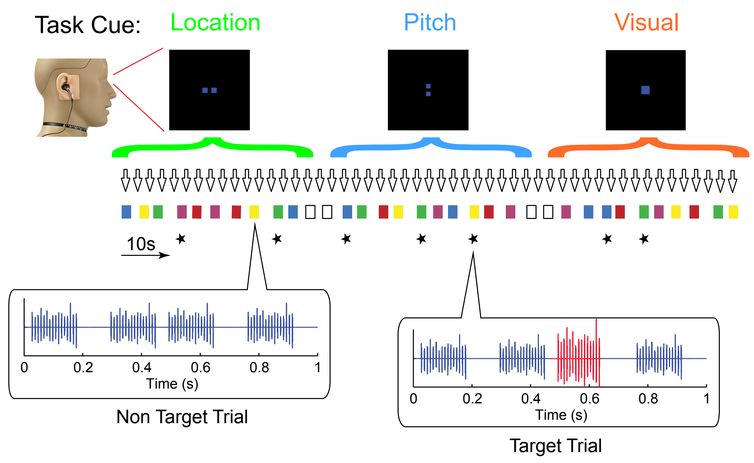


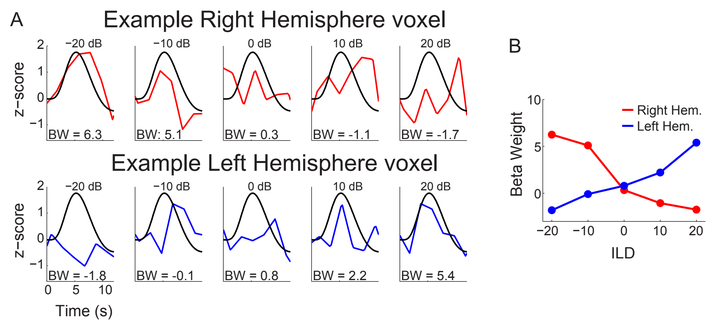
fMRI responses in human AC and inferior colliculus appear dominated by monaural (E0) input. Diotic responses (blue) closely coincide with regions and magnitude of contralateral responses (e.g., red in LH). [Stecker, Rinne, Herron, Liao, Kang, Yund, and Woods, ARO 2006]

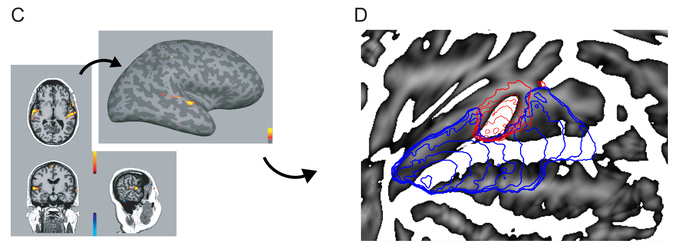


Tuning of fMRI responses in human AC to ILD appear non-monotonic, but overall biased to favor contralateral ear. Relative to monotic response (open symbols), both hemispheres (red for RH, blue for LH) show significant reductions for moderate ipsilateral ILD values. [Stecker and McLaughlin, ASA 2012]

Approach

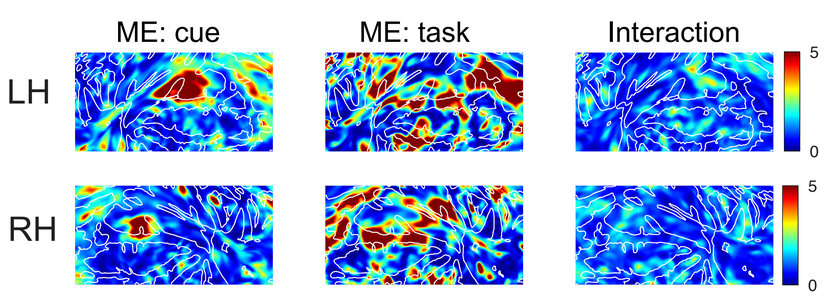




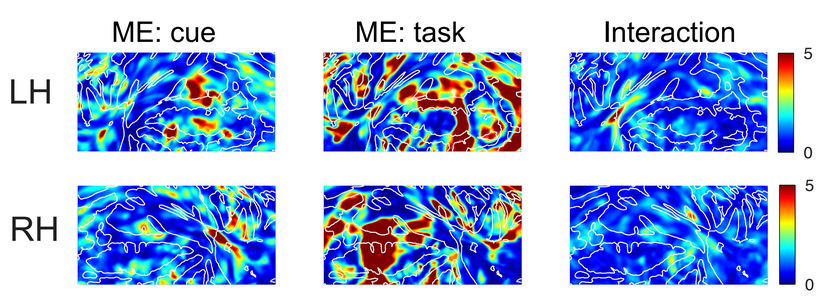


Results

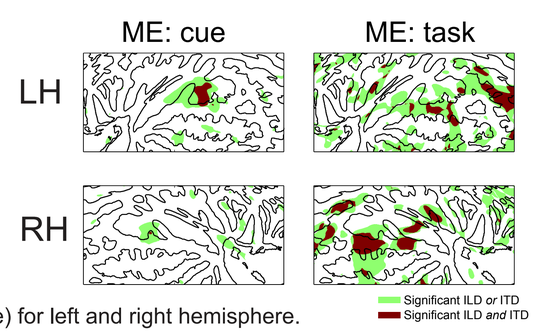
Interaural Level Difference



Interaural Time Difference

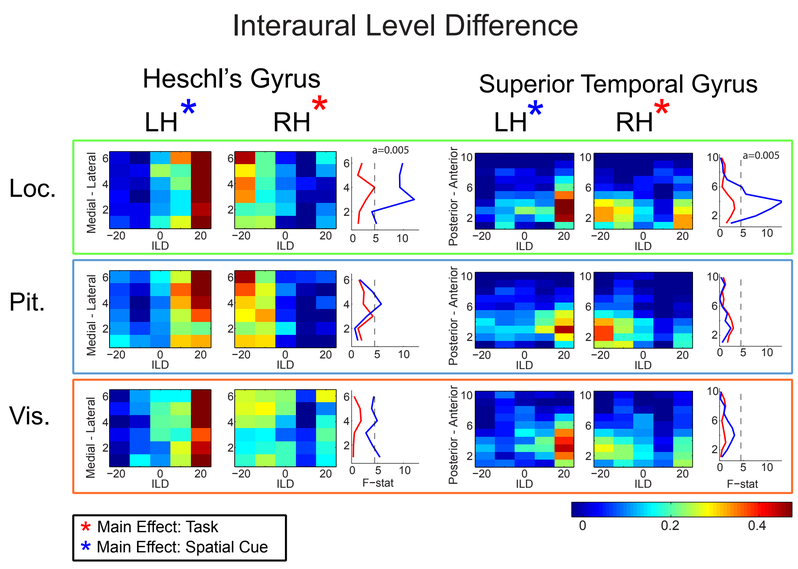


Overlap

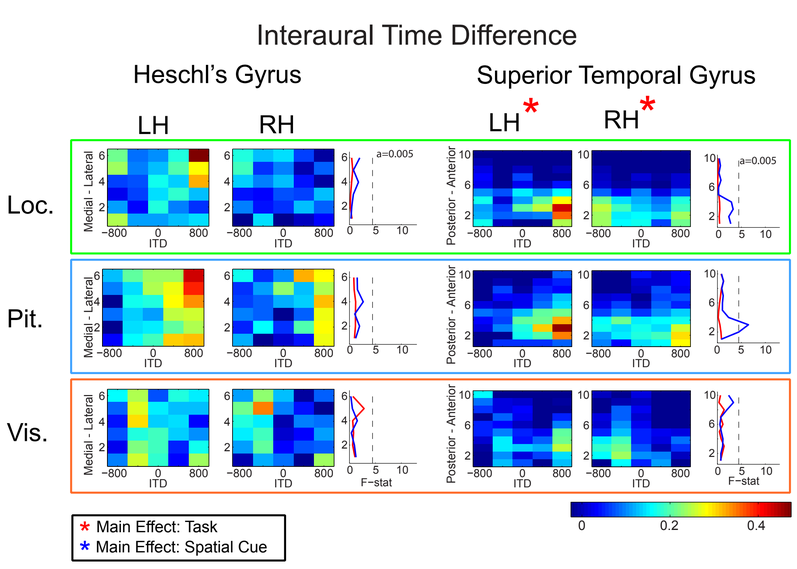


Repeated measures ANOVA with independent between-subjects factors of spatial cue (ILD or ITD values) and task (location, pitch, visual) projected to cortical surface (as above) for left and right hemisphere.

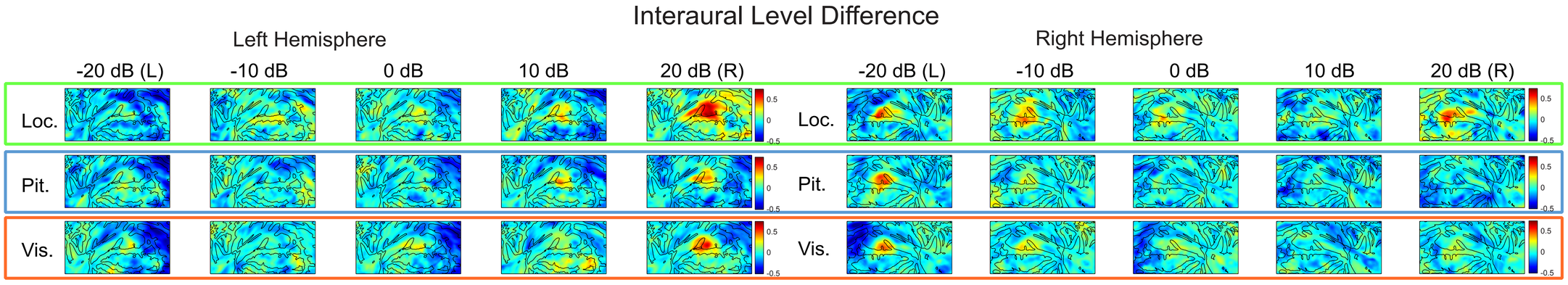
Interaural Level Difference



Interaural Time Difference



Interaural Level Difference



Interaural Time Difference